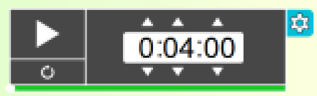
Waves	**Diffraction and polarisation**

Learning objectives	**MUST (6)**	Define diffraction, and explain what affects its extent
	SHOULD (7)	Explain applications of diffraction
	COULD (8/9)	Understand how polarisation of light occurs, and how it can be used

STARTER: Why could I hear you before you entered the room, but not see you?



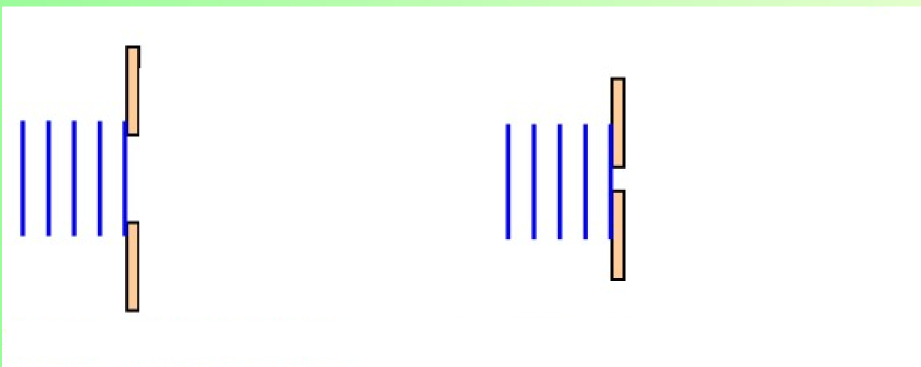
EXTENSION: If I tell you that middle C has a frequency of 261.6 Hz, could you estimate the wavelength of a human voice? (Yes, this is relevant).
(Extra thinking question: Top C (the next C up) has a frequency of 523.3 Hz. Can you predict the frequency of the C above that?) Can you think why this should be?

1046.50 Hz - it doubles every octave. Our auditory systems respond logarithmically, so it sounds the same pitch. Also, it goes on doubling - not a specific number difference - as you can't have negative Hz.

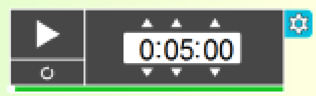
Waves	**Diffraction and polarisation**
MUST (6)	Define diffraction, and explain what affects its extent

Diffraction is the spreading out of waves as they pass a barrier or go through a gap; it is a common property, and all waves diffract.

The pictures below show the same wave passing through two gaps. How do you think the wave will look?



simulator



Diffraction occurs at every gap or barrier; but is most noticeable when the gap/barrier is of a similar dimension to the wavelength of the wave. Diffraction does **not** change the wavelength of a wave, which should stay the same in any diagrams of diffraction.

Green light: wavelength 550 nm(ish)

Waves	**Diffraction and polarisation**
SHOULD (7)	Explain applications of diffraction

Task 1: Can you now use the following piece of information to answer our starter question?

Green light: wavelength 550 nm(ish)

You need to produce a **full paragraph** explaining clearly, using terminology that we have learned, why I could hear you in the corridor but not see you.

Task 2: Which waves on the EM spectrum could diffract around buildings, and what are the implications for their use?

Task 3: For objects of less than 500 nm, we cannot use a visible light microscope. Why not? What would we have to do instead?

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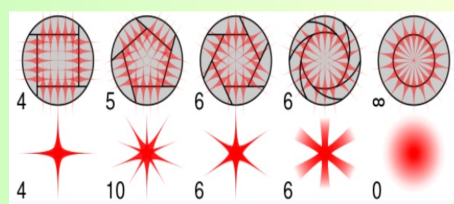
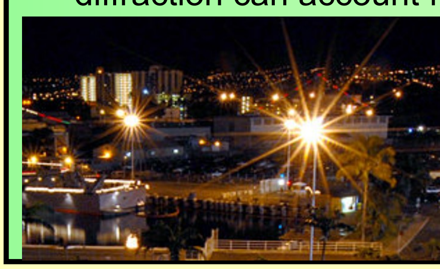
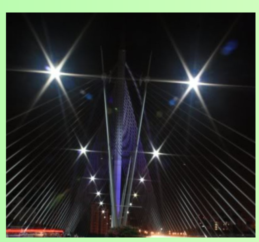
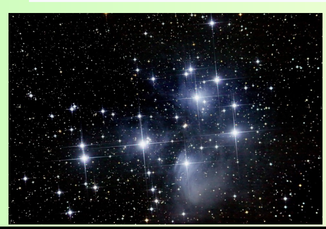
Extra thinking question: have you ever seen a light appear with spikes on TV/ camera image? Can you suggest how diffraction can account for this?





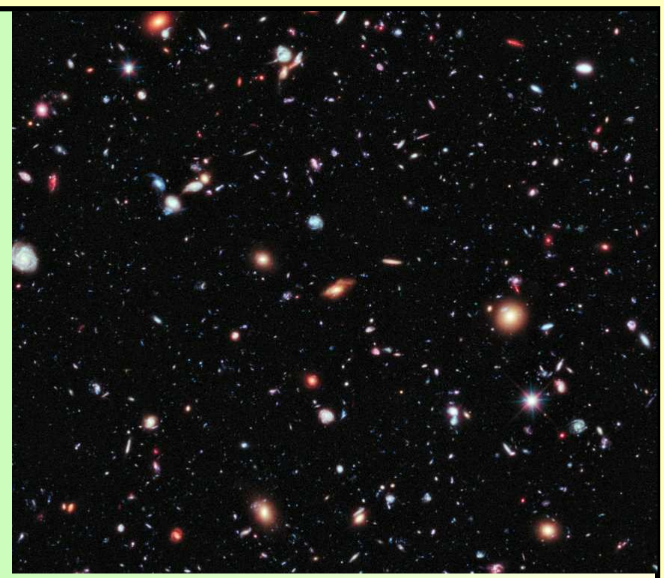




Waves	**Diffraction and polarisation; part 2!**

Learning objectives	**MUST (6)**	Define diffraction, and explain what affects its extent
	SHOULD (7)	Explain applications of diffraction
	COULD (8/9)	Understand how polarisation of light occurs, and how it can be used

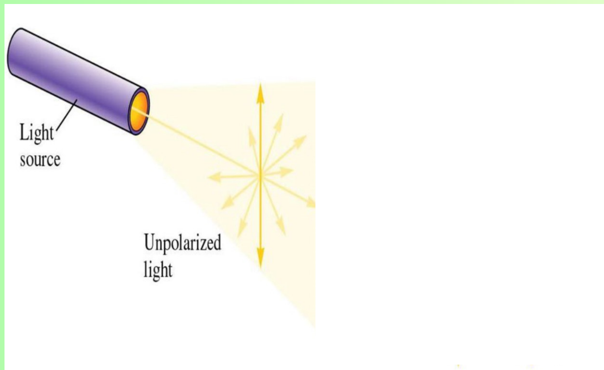
STARTER: This is a Hubble Deep Field image. Which of the bright objects are galaxies, and which are single stars? How do you know, and why does this happen?



Waves	**Polarisation**
COULD (8/9)	Understand how polarisation of light can occur, and how it can be used

Polarisation is a phenomenon that can be applied to some waves; all electromagnetic waves can be polarised.

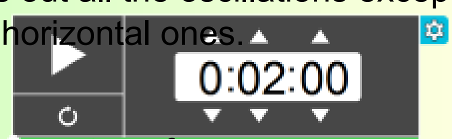
Electromagnetic waves are transverse, and in unpolarised light the waves travel at all orientations.



Polarising filters confine the wave to a single plane: it oscillates in one direction only.

What do you see when you rotate two polarising filters? Why?

'Crossed' polarising filters allow no light at all; one cuts out all the oscillations except vertical ones, the other cuts out all oscillations except horizontal ones.

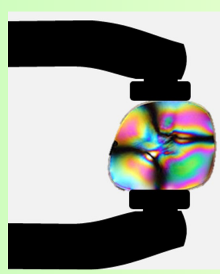


Can longitudinal waves be polarised?

No, because they oscillate parallel to the direction of energy transfer.

Certain polymers can cause colours to appear between crossed polarising filters. In addition, if optically active polymers are under stress this can show as coloured fringes.

stress analysis: plastic lens under compression, viewed between crossed polarising filters



Oct 16-21:59

Waves	**Polarisation**
COULD (8/9)	Understand how polarisation of light can occur, and how it can be used

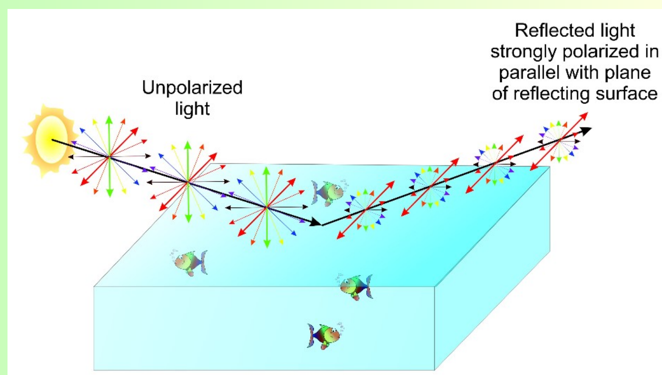
These images of the pond were taken at the same time; the right had a polarising filter. What's the difference? Why?

The image on the right has...

far fewer reflections on the surface of the water; you can see the leaves under the surface, and the reflection of the sky is greatly reduced.

When sunlight hits water, partial polarisation can occur. The light that reflects off it is **not entirely** plane polarised, but there will be more waves oscillating parallel to the water surface.

Polarising filters can reduce these particular waves, so stopping glare from reflections.



I took these two images in the Science corridor, through a polarising filter that I rotated. Can you see and explain the difference?

The light reflects off the plane vertical surface, so is plane polarised in that direction. When I hold the polarising filter in one orientation, the reflected light passes through; turn it 90° and those reflections are blocked

Filming

Waves	**Diffraction and polarisation**

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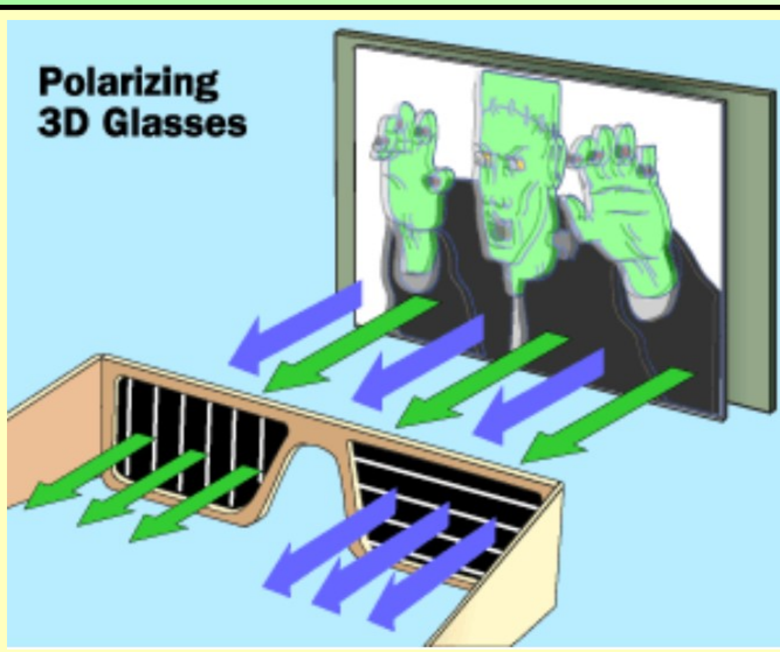
PLENARY:

0:02:00

3D films rely on your eyes seeing different images. Old films used red/green filters to do this: now, we see 3D films in true colour. How do you think we can use one of the phenomena we've looked at today to achieve this? (Think of the glasses at the cinema).

Extension: viewers of 3D films learn quickly not to tilt their heads. Why not?



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